

- Executive Summary
- Company Selection for Benchmark
- Quality Assurance Framework
- **Benchmark Company Observations**
- Industry Quality Assurance Cost Estimates
- Industry Selection of Quality Assurance Methods



The Quality Assurance strategy of world class companies is driven by the business environment and competitive strategy. The following characteristics were shared by the benchmark companies.

— Quality Assurance Strategy Objectives — Quality Assurance Strategy Evolution —

- To support long term competitive strategy
- To respond effectively to business environment
- To mitigate risk specific to strategic commodities
- To leverage and support procurement strategy
- Based upon expectation of high supplier performance
- The objective of supplier quality assurance has shifted from defect identification to supplier development
- The cost and responsibility for proving eligibility to provide a part or commodity has shifted from the buyer to the supplier
- Quality system standards originally based on ISO 9000 have been tailored to specific industries and companies, addressing the needs and specific risks of those industries

There are several common characteristics of the observed Quality Assurance Methods used by the companies visited.

— Quality Assurance Methods Used —

- Leverage all Quality Assurance Categories to support Quality Assurance Strategy
- Integration of multiple quality assurance methods to support Quality Assurance Strategy
- Methods applied concurrently throughout the acquisition timeline
- Implementing a formal supplier scorecard process is a top priority
- Key Focus:
 - To prevent production of nonconforming materials
 - To improve performance of current or future part numbers

World class companies tailor their organizational structures to support their Quality Assurance Strategy.

— Quality Assurance Organization —

- Structures range from field offices to cross-functional commodity management teams
 - Ownership of implementation varies
- Engineering experts define:
 - Method processes (who, what, where, and how)
 - Detailed inspection plans
- Engineering experts define detailed inspection plans
- Guidance and parameters provided to personnel responsible for implementation
- Increasing visibility of quality organization to executive level
- Teams conducting supplier qualification assessments are tailored to commodity and heavily supported by engineering experts
- Personnel implementing quality assurance methods have technical skills and

In addition to tailoring their organizational structures, world class companies also tailor their application of technology to support their Quality Assurance Strategy.

***— Application of Technology to Quality Assurance
Organization —***

- Visibility of data ranges from global visibility of integrated supplier specific data, to discrete databases with limited compatibility
- The most sophisticated databases are developed internally by the company
- Prevalent use of commercial-off-the-shelf spreadsheet packages for data analysis
- No observations of commercial-off-the-shelf applications dedicated to supplier selection or supplier quality
- Real-time adjustment of quality assurance method intensity based upon performance data
- Reject/escape information is aggressively tracked and recorded to support root cause analysis and supplier feedback
- Prevalent use of electronic transmission of conformance documents

The following benchmark company examples illustrate how world class companies position Quality Assurance Strategy to support long term competitive advantage. The organizational structures and technology applications are also analyzed.

Company Description	Link to Business Strategy	Overall Quality Assurance	Method Selection	Organizational Structure	Technology Application
A Manufacturer of semiconductors and electronics products, purchase: Direct Materials	✓	✓	✓	✓	✓
B Manufacturer of semiconductors and electronics products, purchase: Fabrication Equipment	✓	✓	✓	✓	✓
C Manufacturer of semiconductors, purchase: Customized Silicon	✓	✓	✓	✓	
D Manufacturer of high quality automobiles, purchase: Automotive Components and Sub-assemblies	✓	✓	✓	✓	
E Premium service lessor of trucks to distribution service providers, purchase: Trucks and Truck Components	✓	✓	✓	✓	
F American air carrier, purchase: commercial aircraft	✓	✓	✓		
G Manufacturer of aerospace systems, purchase: aerospace components	✓				✓

Electronics Industry Company “A”

Supplier quality is viewed as key to achieving competitive advantage and future business success.

— Company “A” Semi-conductor Group —

Importance of Quality	
HIGH	Competitive advantage requires quality <ul style="list-style-type: none">• Low Cost Fabrication requires high yield + minimal scrap

Partnership Potential	
HIGH	Supplier alliances and continuous improvement initiatives are key focus areas <ul style="list-style-type: none">• History of successful partnerships



— Supplier Performance Expectations —

- At Company “A”, our focus is on value, growth and stability as we pursue our vision of becoming a premier electronics company providing world leadership in digital solutions for the networked society.
- This strategy cascades down the Company “A” organization and extends to all our suppliers. High performance becomes more and more critical as the expectations and requirements of the market become more demanding.
- **As a supplier you are key to our success.**

Although the quality assurance program is both mature and world class, the Quality Assurance Strategy seeks to maintain competitive advantage by driving ongoing program improvement.— *Supplier Quality Assurance Strategy* —

Strategy Elements	Priorities	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection	★ Dock to Stock	75% all part numbers certified dock to stock		▲			▲
Supplier Management	★ Continuous Improvement		➡ CETRAQ	▲		▲ ➡	
Material Sourcing for Quality & Design				▲	... not observed ...		
Conformity to Design				▲			▲
Failure Management	★ Supply disruption notification Supplier corrective			▲			▲
Organization	★ Commodity Teams		➡ Commodity Mngmt Teams	▲			▲
Technology/ Information Systems				▲			▲

▲ = Observed Performance CETRAQ = Cost, Environmental compliance, Technology, Responsiveness, Assurance of supply, & Quality
★ = Key Focus Area
➡ = New Program

Successful implementation of the Quality Assurance Strategy requires active involvement in supplier selection/qualification activities.

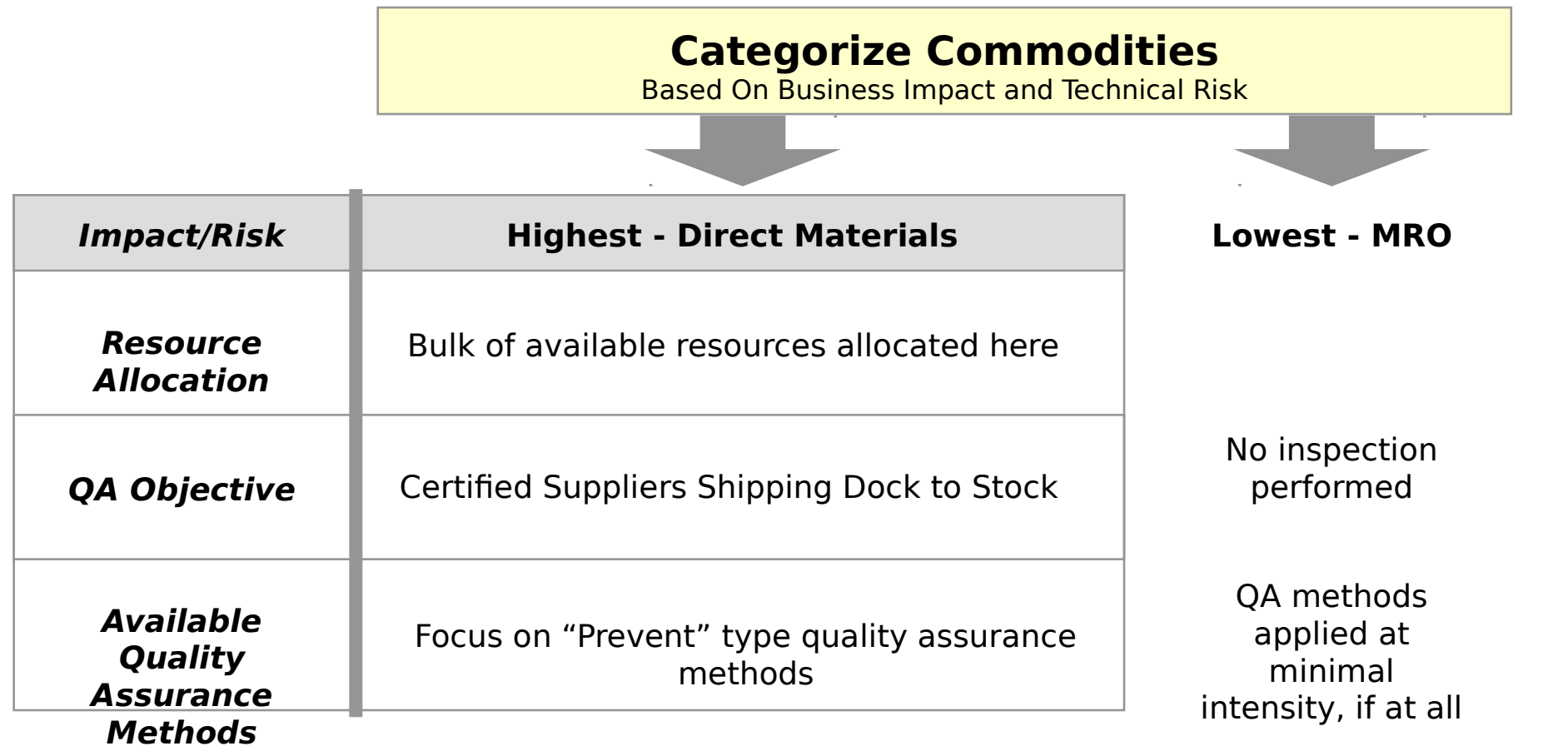
← Quality Assurance Methods Acquisition Timeline →

QA Category or Method	Origin of Need	Design Specifications Development	Supplier Selection	Start Production	In-Process	End Production	Shipment /Delivery	Final Use
Supplier Qualification			Quality System Assessment					
Supplier Selection Criteria			Material Engineering					
Supplier Certification				Dock to Stock Certification				
Incoming Inspection							Incoming Inspection or COC Check	
Supplier Feedback			Supply Quality Reporting					
Supplier Feedback			CETRAQ					
Supplier Development				Supplier Training				
Failure Management							Supply Disruption Notification	

CETRAQ = Cost, Environmental compliance, Technology, Responsiveness, Assurance of supply, & Quality

COC = Certificate of Conformance

The Supplier Quality Assurance Strategy sets the performance goal for “strategic” commodities, those with the greatest business impact.



Accomplished at Executive Level, based on information from the Commodity Teams

The Supplier Quality Assurance Strategy defines which suppliers the performance goal will be applied to, and provides the guidelines for achieving the goal.

Performance Goal: Certified Suppliers Shipping Dock to Stock

Application: Strategic Suppliers for Strategic Commodities

— **Certification Process** —

SELECT	Most Capable Suppliers <ul style="list-style-type: none">Initial Screening (price list + lab results)Quality System AssessmentMaterial Engineering Technical Review & First Article Testing	CERTIFY	Dock to Stock Certification <ul style="list-style-type: none">Supplier completes all required actionsVerification of action completionApproval and database entry
EVALUATE	Performance History <ul style="list-style-type: none">Quality System Assessment resultsSupply Disruption NotificationsSupply quality reporting data supplier data + inspection results + manufacturing facility findingsPerformance on CETRAQ	MAINTAIN	Supplier Maintenance <ul style="list-style-type: none">Ongoing excellent quality performanceCETRAQ feedbackSite visit twice a year Includes technical reviewSupplier visits to Company "A" Two to four times a year

OBSERVATIONS

- Standardized formal process
- Part-specific specifications (standardized across the company) drive certification process details
- Intensity of the Quality System Assessment is specific to the supplier

Although the performance goal is the same for both commodities, differences in risk characteristics drive very different portfolios of quality assurance methods.

Performance Goal: Certified Suppliers Shipping Dock to Stock						
Commodity Examples	RISK FACTORS				Quality Assurance Methods	
	Strategic Commodity	High Economic Impact of Failure (Yield & Scrap)	Failure Identification	History of Product Conformance		
Sputter Targets	Yes	Yes	Can Reliably Verify Conformance	Good Quality Performance	➤	<ul style="list-style-type: none">Strategic suppliers certified99% of receipts Dock-to-StockLimited incoming inspection<ul style="list-style-type: none">Supplier/part not certifiedDiscrepancy found - certified supplier/partFirst article test
Photo Mask	Yes	Yes	Very Difficult	Testing and Performance Issues	➤	100% Incoming Inspection all critical performance elements

- Observations:
- Cost of material is not a driver (Sputter Targets are second most expensive commodity)
 - "Criticality is not an excuse for inspection"
 - Specific Quality Assurance method applied out of portfolio based on supplier/part
 - Position/status in certification process

CETRAQ is a Company "A" acronym for Cost, Environmental compliance, Technology, Responsiveness, Assurance of supply and Quality. The objective of CETRAQ is to provide a basis for continuous improvement.

Critical Focus Areas

- COST of products/services sold
- Price level versus target
 - Cost reduction
 - Unsolicited Price Reduction
- ENVIRONMENTAL COMPLIANCE
- Environmental Policy
 - Compliance rate
 - Awards
- TECHNOLOGY needed to support "A"
- Technical Leadership
 - New Products
 - Innovations
- RESPONSIVENESS to needs
- Response to inquiries
 - Anticipation
 - Continuous improvement
 - Communication and ease of doing business
- ASSURANCE OF SUPPLY order delivery
- Delivery on-time
 - Cycle-time
 - Continuity & Flexibility
 - Packing and Logistics compliance
- QUALITY of deliveries
- Parts-per-million Quality
 - Process Capability
 - Corrective Action implementation efficiency

Supplier Feedback

YOUR CURRENT PERFORMANCE	World-Class Performance -Reference-	Company "A" Specified Performance Level	YOUR YEAR-END GOAL FOR IMPROVEMENT
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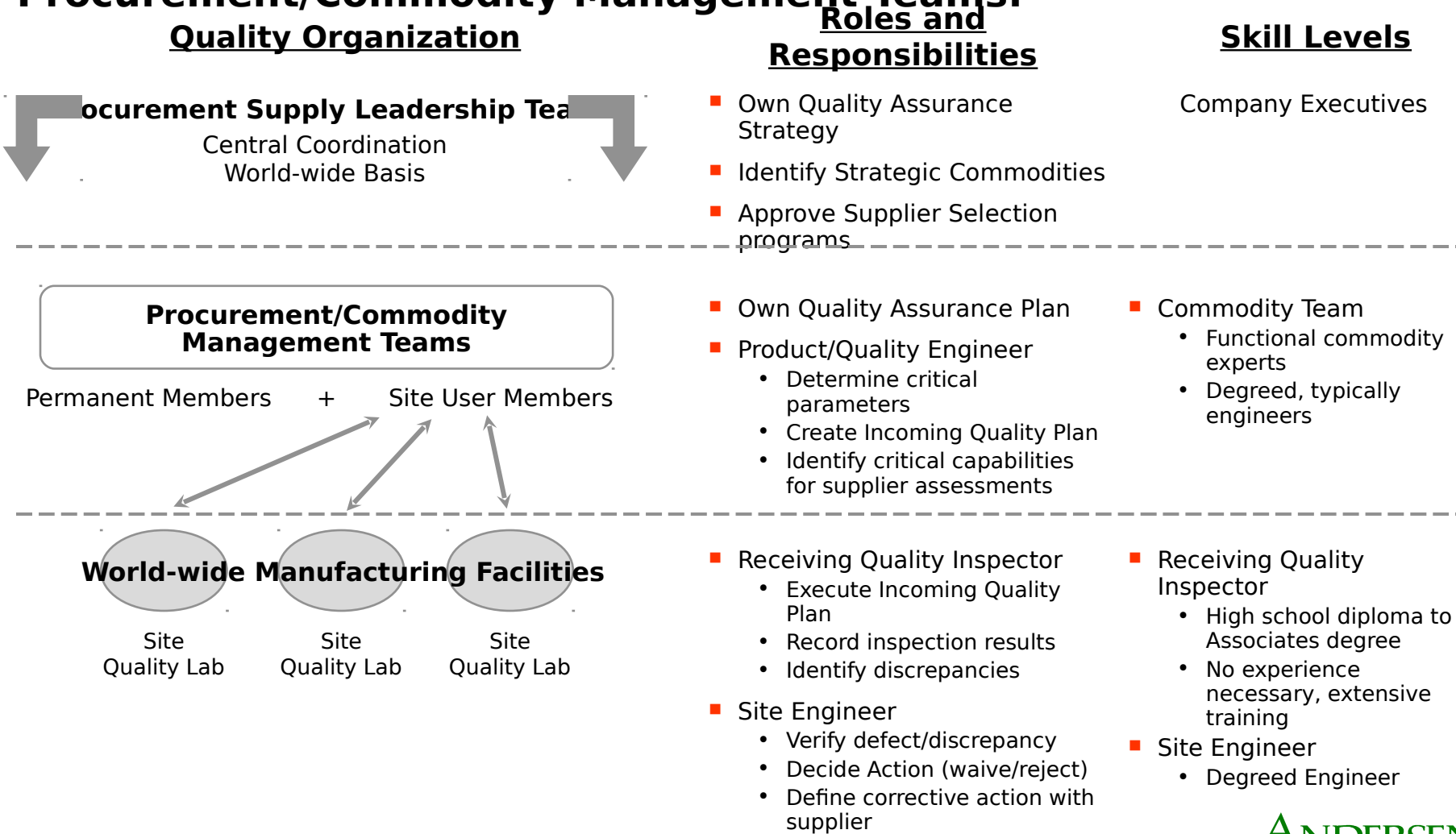
CETRAQ Implementation

- Critical Focus Areas identified at executive level, standardized
- Commodity teams prioritize requirements in each focus area
- Specific ratings defined by commodity

Use of Rating Information

- Tool for supplier to monitor their performance
- Basis for continuous improvement
- Recognize best performing suppliers an annual excellence award
- Basis for business allocation

The corporate quality group has been dissolved and quality personnel are now permanent members of Procurement/Commodity Management Teams.



Company “A” supports world class quality assurance objectives with world class information capabilities.

-- Supplier/Part Performance Data Visibility --

Primary User	Qualification Certification Status	Assessment Ratings & Progress	Deficiency Notification	Delivery Performance	Inspection Results	Manufacturing Findings	Field Failures	Overall
Commodity Team	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line
FABs	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line
Quality Inspectors	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line
Suppliers	Hardcopy Report	Hardcopy Report	Hardcopy Report	Hardcopy Report	Hardcopy Report	Hardcopy Report	N/A	Hardcopy Report

Visibility of
-- Quality Plan Data --

Critical Parameters	Type Inspection	Sample Size
On-line	On-line	On-line
On-line	On-line	On-line
On-line	On-line	On-line
N/A	N/A	N/A

-- Observations --

- Sophisticated
- Developed in-house
- Client Server
- Interconnected databases
- Uses supplier qualification/certification status, and product conformance history to automatically set inspection type, frequency and sample size
- Automatic update of supplier history
- World-wide to site/supplier-specific views

**Electronics
Industry
Company “B”**

Corporate executives recognize the importance of improving fabrication equipment supplier quality, allocating the resources necessary to develop a robust quality assurance program.

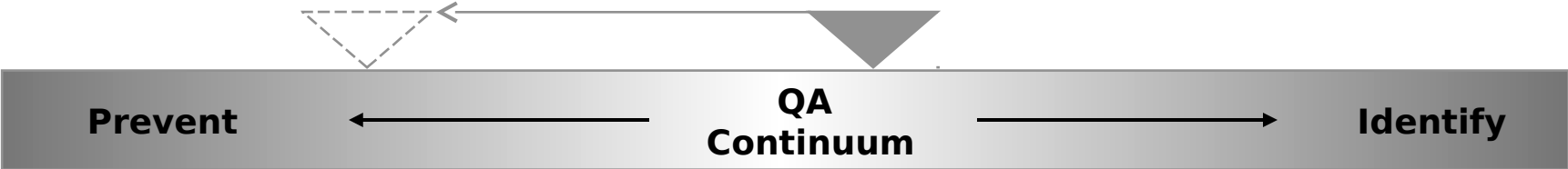
Importance of Quality	
HIGH	Current quality of fabrication equipment is a barrier to achieving competitive advantage.
HIGH	Long lead times reduce return on investment for new FAB <ul style="list-style-type: none">• Time to receive and install equipment directly impacted by quality
HIGH	Business directive to reduce cost per wafer <ul style="list-style-type: none">• 60% of FAB cost is equipment• Failures at production bottle necks cost about \$40,000 per hour in lost revenue• 40% of equipment failures due to low software mean-time-between-failure

— New Focus Area —

- Previously, corporate and manufacturing attention solely on direct materials
- Fabrication Equipment was ignored - “Customers don’t care how semiconductors are manufactured”
- Business case showing cost impacts caught corporate and manufacturing attention
- Have started setting hardware and software performance expectations, and communicating them to suppliers

— Fabrication Equipment Supply Base —


- Worlds largest “garage shop”
- Technical capability high
- Quality system capability low





The Equipment Supplier Excellence Strategy reflects both the importance of quality in achieving competitive advantage, and the maturity level of buyer and supplier quality programs.

— Equipment Supplier Excellence Strategy —

Strategy Elements	Priorities	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection	Supplier Qualification	Data Driving Selection	Qualification				
Conformity to Design							
Supplier Management	★ Report Card Continuous Improvement	DTPRCT	SPI	Development & Training			
Material Sourcing for Quality & Design	Early Supplier Involvement (ESI)	ESI					
Failure Management	★ Defect reduction of subsequent deliveries		FRACAS				

 = Observed Performance

 = Key Focus Area

 = New Program

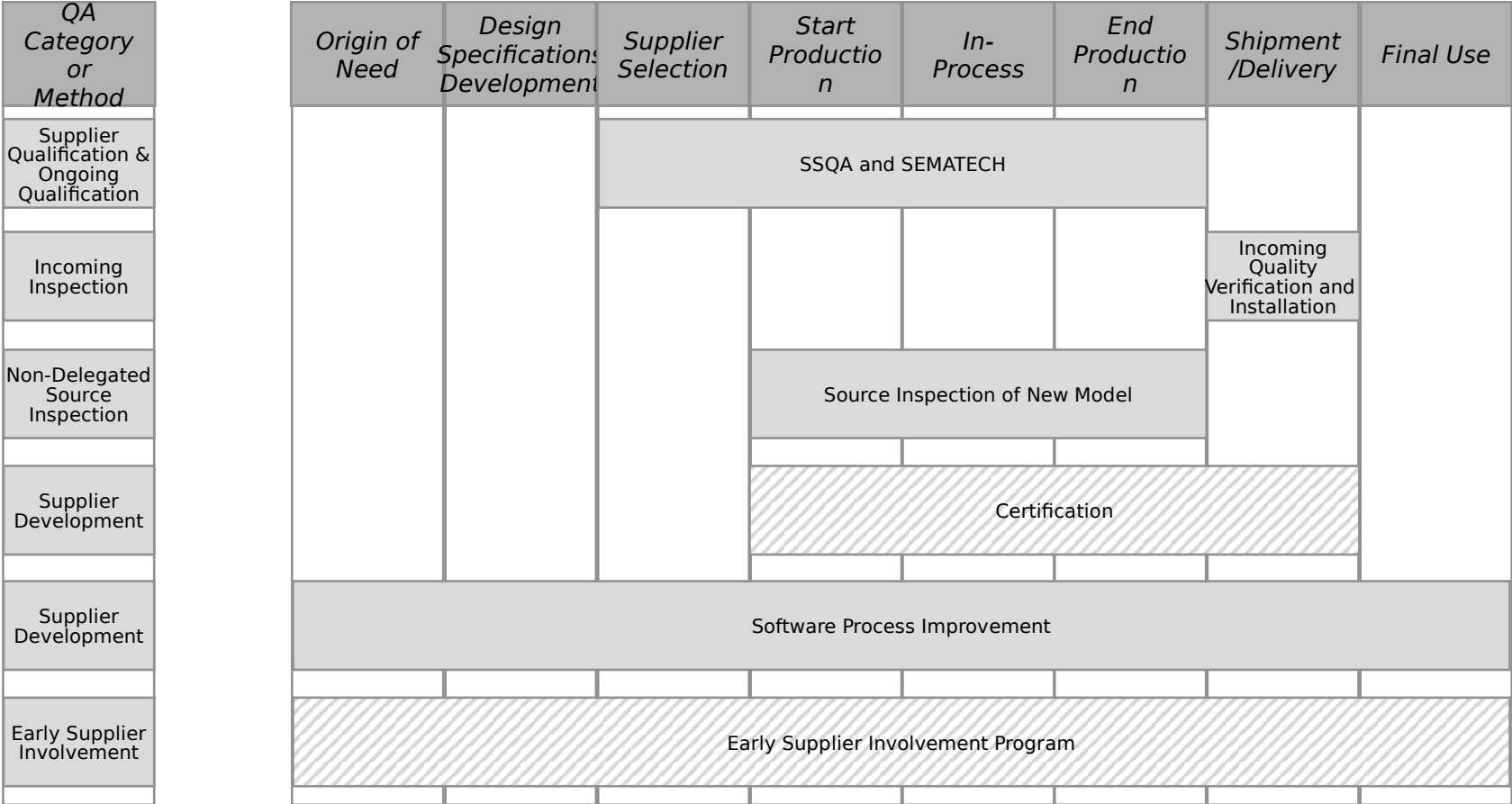
SPI = Software Process Improvement


DTPRCT = Delivery to Production Reduced Cycle Time

FRACAS = Failure Reporting Analysis and Corrective Action System

The Equipment Supplier Excellence Strategy is still being developed and implemented, with a goal of achieving reliable supplier quality.

← Quality Assurance Methods Acquisition Timeline →



 Future Programs

The current focus of the Equipment Supplier Excellence Strategy is to transfer responsibility for meeting equipment quality and reliability requirements from buyer to supplier.

Performance Goal: Help equipment suppliers improve quality and develop programs to ensure

quality and reliability requirements are met

Application: Strategic Equipment Suppliers

— Plan to Achieve Performance Goal —

Sponsorship

- Gain funding and corporate support
- Executive level and manufacturing

Gain Supplier Attention

- Centralized supplier management
- Leverage entire semiconductor industry via SEMATECH
- Focus on “strategic” suppliers

Supplier Qualification and Rating

- SEMATECH Standardized Supplier Quality Assurance (SSQA) Standards
Three modules: 1) Quality system 2) Member company reqmts 3) Software quality
- SSQA areas for improvement validated and ranked
- Continuous improvement plan developed & monitored

Supplier Development

- Quality assurance training consortium
- Site visits to monitor suppliers progress
Are they using the processes they developed?
- Expert assistance -- upon request

Although the suppliers are not yet mature enough for rollout, the Early Supplier Involvement process has been outlined.

— Equipment Supplier Activities —

— Company “B” Responsibilities —

DESIGN IN:

- ✓ Quality -- so equipment operations are defect free from the initial start-up
- ✓ Reliability
- ✓ Predictive maintenance techniques
- ✓ Flexibility to accommodate changes in production method and successive product models
- ✓ Safety to prevent operator errors and injury
- ✓ Improved Production Technology and Manufacturing Method - automated methodologies

OTHER ACTIVITIES

- ✓ Use Software Process Improvement (SPI) model
- ✓ Conduct a joint design review and participate in joint improvement of bottleneck equipment
- ✓ Use Failure Reporting, Analysis, and Corrective Action System (FRACAS) data to address installation and operational problems

- ✓ Conduct Standardized Supplier Quality Assessment (SSQA)
- ✓ Select approved suppliers only
- ✓ Share technology road maps and future business directions as early as possible
- ✓ Participate in the supplier’s design reviews
- ✓ Test future generation equipment
- ✓ Provide equipment requirement forecast
- ✓ Provide detailed information on all installation and operational problems
- ✓ Help the suppliers to become certified
- ✓ Conduct first article testing

The Failure Reporting Analysis and Corrective Action System (FRACAS) data is now available, the next step is to teach equipment suppliers how to use the data to drive subsequent improvement.

FRACAS DATA

- Just began collecting defect detail from FABs
- Available by machine
- Suppliers have real-time access to "live" machine data
 - Suppliers have maintenance contracts

POTENTIAL USES

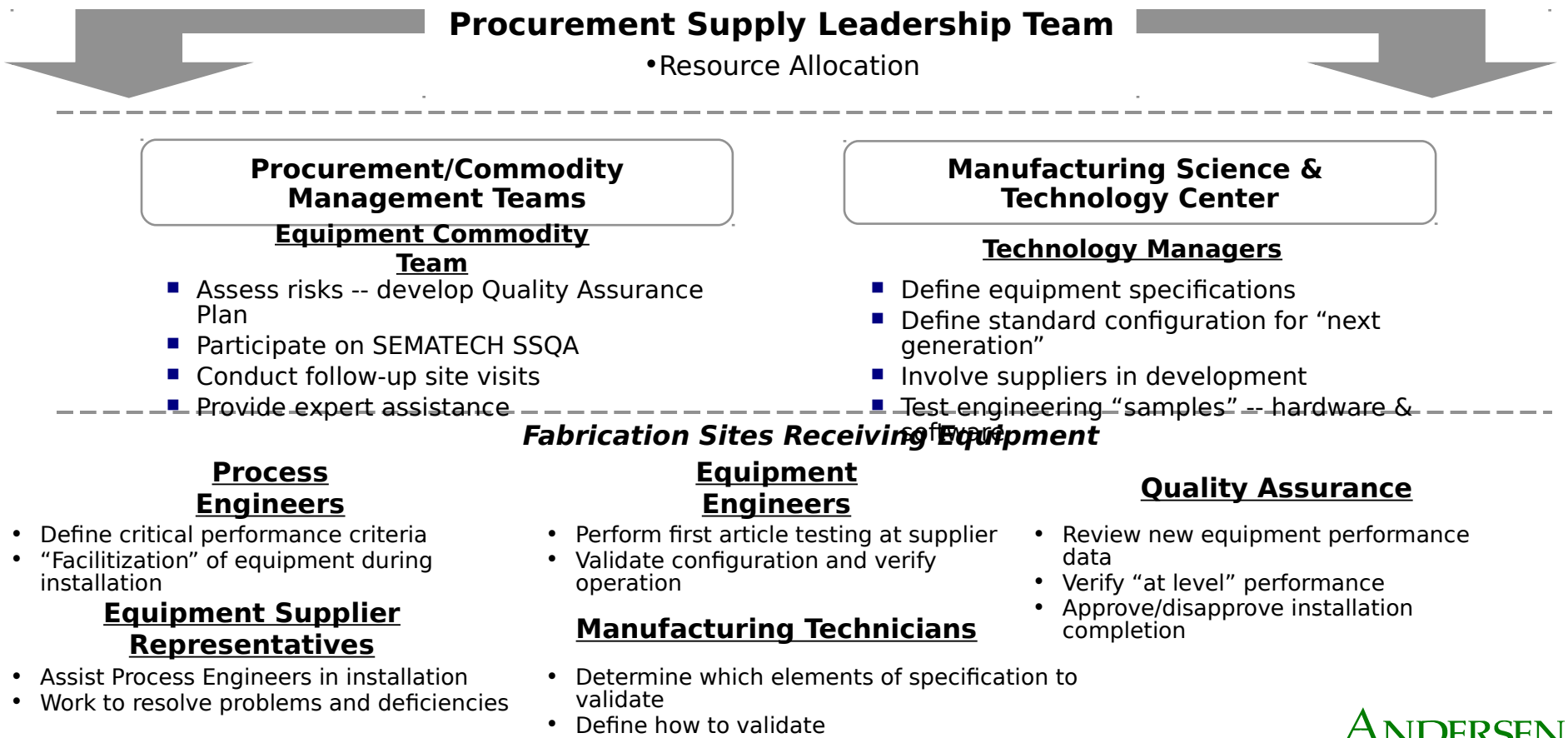
- Input to Early Supply Involvement Program
 - For suppliers to "build quality in"
- Use to accelerate installation
 - Pull failure data from "pilot" line
 - Incorporate "fixes" into subsequent shipments of like-items

NEXT STEPS

- Teach suppliers what FRACAS information can be used for
- Supplier development of a process to use FRACAS data
- Monitor suppliers use of their FRACAS process, as well as encourage further development
- Provide ongoing guidance as needed/requested

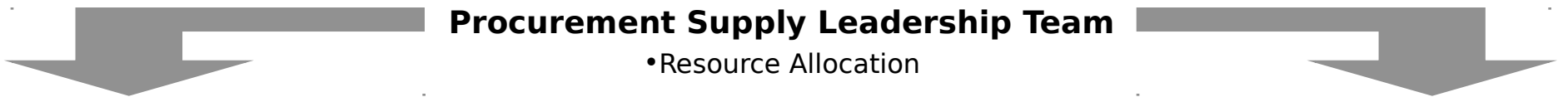
Although steps are being taken to prevent defects for fabrication equipment, considerable resources must be devoted to installation and inspection given current supplier quality and reliability.

Roles and Responsibilities by Quality Organization —



Although steps are being taken to prevent defects for fabrication equipment, considerable resources must be devoted to installation and inspection given current supplier quality and reliability.

Equipment Supplier Quality Assurance
— Organization/Job Classification and Responsibilities —



Equipment Procurement/Commodity Management Team

- Assess Risks
- Develop Quality Assurance Plan
- Participate on SEMATECH SSQA
- Conduct follow-up site visits
- Provide Expert Assistance

Manufacturing Science & Technology Center Technology Managers

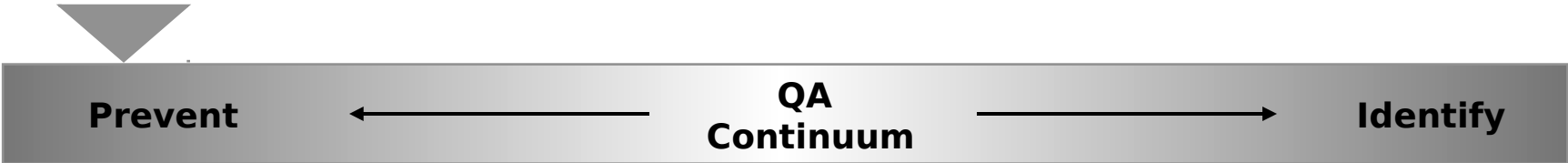
- Define equipment specifications
- Define standard configuration for “next generation”
- Supplier involvement in development
- Test engineering “samples,” both hardware and software

	<u>Process Engineers</u>	<u>Manufacturing Technicians</u>	<u>FAB Quality Assurance</u>	<u>Equipment Engineers</u>	<u>Equipment Supplier Representatives</u>
Fabrication Sites Receiving Equipment	<ul style="list-style-type: none">• Define critical performance criteria• “Facilitization” of equipment during installation	<ul style="list-style-type: none">• Determine which elements of specification to validate• Define how to validate	<ul style="list-style-type: none">• Review new equipment performance data• Verify “at level” performance• Approve/disapprove installation completion	<ul style="list-style-type: none">• Perform first article testing at supplier (source)• Validate configuration and that equipment “runs”	<ul style="list-style-type: none">• Assist Process Engineers in installation• Work to resolve problems and deficiencies

Electronics Industry Company “C”

The competitive strategy of Company “C” is based on: ability to develop new technology at a rapid rate, high manufacturing yield and new factory ramp up.

Competitive Strategy <ul style="list-style-type: none">■ Develop and market new technology at a rapid rate. Product life cycle very short.■ Maintain high yield from manufacturing process in order to minimize costs.■ Build and ramp up new factories as quickly as possible.	Importance of Quality - HIGH <ul style="list-style-type: none">■ Competitive advantage requires low cost development of high quality products and new technology.■ Customer values high quality and performance, more than price.
Supplier Performance Expectations <ul style="list-style-type: none">■ Fulfill technology and volume requirements of future production.■ Ensure material quality does not stop manufacturing.■ Mutually agree upon product and service performance metrics.	Partnership Potential - HIGH <ul style="list-style-type: none">■ Business philosophy to partner and collaborate.■ Wants to maintain core competency of semiconductor manufacturing; not wafer production.■ Supplier base has high cost capital investments, resulting in an incentive to partner in order to secure long term relationship.■ Supplier play critical role in the development of new technology of materials



Silicon is managed as a strategic commodity, due to its high impact of failure and technology risk.

Business Impact - HIGH

- Impact of failure very costly
 - Manufacturing process extremely expensive; delays cost hundreds of thousands of dollars
 - Cost structure very sensitive to yield, which is reduced by poor quality silicon
 - Cost of lost output due to manufacturing delays usually very high
- Failure identification very costly
 - Non-destructive inspection requires high cost clean room environments and is prohibitive

Technology Risk - HIGH

- Silicon is crucial to competitive advantage
 - Silicon is building block to new technology applications
- Technology evolves very rapidly
 - Continuously developing next generation silicon
- Limited supplier base due to complex technology and material production requirements

Company “C” has mature strategy elements and therefore is working to lock in technology faster and better by concentrating on metrology and joint product development.

— Supplier Quality Assurance Strategy —

Strategy Elements	Priorities	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection				▲			▲
Conformity to Design	★ Metrology Development			▲			▲
Supplier Management				▲			▲
Material Sourcing for Quality & Design	★ Joint Product Development			▲			▲
Failure Management				▲			▲
Organization				▲			▲
Technology/ Information Systems				▲			▲

- ▲ = Observed Performance
- ★ = Key Focus Area
- ➡ = New Program

Company “C” uses multiple quality assurance methods concurrently throughout the acquisition and focus on prevention.

← Quality Assurance Methods Procurement Timeline →

QA Category or Method	Origin of Need	Specification	Supplier Selection	Start Production	In-Process	End Production	Shipment /Delivery	Final Use		
Supplier & Ongoing Qualification			Assess Quality System	Assess Quality System Levels 1-2 Years						
Conformity to Design		Materials Qualification								
Conformity to Design				Metrology Development						
Conformity to Design										
Conformity to Design				Process Control and Excursion Management						
Supplier Feedback				Supplier Ranking & Rating Silicon Status Report, PQs and SCQI Awards						
Feedback & Failure Management		Action Required								
Supplier Development		Supplier Training								
Early Supplier Involvement		Steering Committee Meetings								
Joint Product Development		Technology Development Group								

To achieve the supplier performance goal for future part numbers, Company “C” focuses on materials sourcing for quality and design, and front-end conformity to design methods.

Performance Goal: Develop and implement next generation materials for new process introductions

consistent with cost, quality, schedule and environmental objectives

Application: Silicon Suppliers

Quality Assurance Category	Company Specific Quality Assurance Method	Outcome of Method
Conformity to Design	Materials Qualification	Increase visibility of critical characteristics of silicon and apply learning to new products
Material Sourcing for Quality and Design	Early Supplier Involvement	Provide supplier lead time to develop and verify its capability to fulfill future technology demands
	Steering Committee Meetings	Continuous development of executive level relationship with supplier base
	Technology Development Group	Dedicated group engineers within commodity team to work with suppliers to develop new technology
Conformity to Design	Metrology Development	<i>Jointly</i> increase visibility of critical characteristics of silicon and apply learning to new products

Company “C” uses an additional mix of quality assurance methods to achieve the supplier performance goal for current part numbers.

Performance Goal: To supply high quality silicon

Application: Silicon Suppliers

Quality Assurance Category	Company Specific Quality Assurance Method	Outcome of Method
Supplier Management	Ongoing Supplier Qualification	Verification of supplier quality systems and process control
	Supplier Ranking and Rating	Provide supplier with performance data relative to supplier base
	Silicon Status Report	Provide supplier with continuous performance feedback
	Action Required	Control and document corrective action requests for process or quality improvement
Conformity to Design	Process Control and Excursion Management	Continuous verification of reliability and capability of supplier’s manufacturing process
Supplier Selection	Supplier Certification	Certified product shipped to stock, incoming inspection limited to review of conformance documentation on sample basis

Company “C” has a dedicated silicon commodity management team composed of four sub-teams, reflecting the importance of silicon to business success.

— Silicon Commodity Management Team —

Commodity Sub-Team	Roles and Responsibilities	Skill Levels
Commercial	<ul style="list-style-type: none">■ Volume requirement forecasts■ Buying	MBA
Quality	<ul style="list-style-type: none">■ Supplier quality■ Total quality management■ ISO9000 Certification	Experienced Engineers
Technology	<ul style="list-style-type: none">■ Joint product development■ Early supplier involvement for new technology	Design and Manufacturing Engineers
Application	<ul style="list-style-type: none">■ Test wafer & reclamation process■ Inventory management across fabrication plants	Operations Engineers

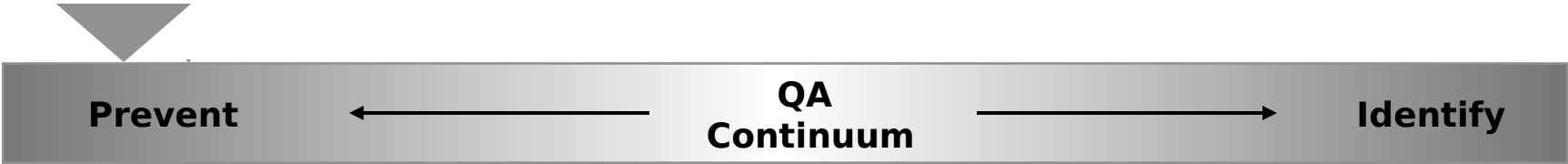
Information technology enables Company “C” to make fact-based decisions, and provides a quantitative foundation for the quality assurance strategy.

Quality Assurance Method	Application of Technology
Materials Qualification	<ul style="list-style-type: none">■ Aggressively capture and analyze material capability and reliability
Early Supplier Involvement	<ul style="list-style-type: none">■ Supports sophisticated forecasting applications
Steering Committee Meetings	<ul style="list-style-type: none">■ Compilation of performance, metrology, and forecast related data
Technology Development Group	<ul style="list-style-type: none">■ Analyze test data and simulate performance levels
Supplier Certification	<ul style="list-style-type: none">■ Supports materials qualification■ Suppliers transmit reliability and capability statistical process control data electronically
Metrology Development	<ul style="list-style-type: none">■ Aggressively capture and analyze material capability and reliability
Supplier Ranking and Rating, Silicon Status Report	<ul style="list-style-type: none">■ Compilation of supplier performance data from multiple sources accessible on shared server drives
Process Control and Excursion Management	<ul style="list-style-type: none">■ Analyze test data and simulate performance levels

Automotive Industry Company “D”

The competitive strategy of Company “D” is based upon its ability to leverage the just-in-time production system by developing its supplier base to achieve operational excellence.

Competitive Strategy <ul style="list-style-type: none">■ Follow successful innovation, rather than innovate■ Operational excellence, outperform competitors on product value and quality■ Continue to leverage Company “D” Production System as a source of competitive advantage	Importance of Quality - HIGH <ul style="list-style-type: none">■ Competitive advantage requires low cost production of high performing products■ Production system requires zero defects delivered on a just-in-time basis■ Culture encompasses pride and obsession with quality■ Customer purchase decision based on quality
Supplier Performance Expectations <ul style="list-style-type: none">■ Support Company “D” Production System and deliver on just-in-time basis■ Become part of the Company “D” family■ Willing to jointly develop or design new products■ Willing to continuously improve processes or products	Partnership Potential - HIGH <ul style="list-style-type: none">■ Business philosophy to partner fostered by business culture■ Requires continuous improvement from supplier and recognizes value of supplier development■ Production system requires long term investment by both parties into supplier-buyer relationship



The impact of failure of automobile components is extremely high for Company “D.” Delivery of defective components to the production line results in production disruption, with a severe business impact.

Business Impact - HIGH

- Impact of failure very costly
 - Cost of lost output due to manufacturing delays very high; short lead time on final automobile customer orders
 - Final automobile safety very sensitive to quality of components
 - Final automobile performance very sensitive to quality of components
- Failure identification costly to production system
 - Nonconformance is identifiable in advance, but just-in-time processes not compatible to inspection

Technology Risk - LOW

- Limited supply base with technical capability to produce zero defects on a just-in-time basis
- Components not crucial to current or future competitive advantage, relative to operational excellence
- Manufacturing operation is complex, but processes are mature and standardized

Company “D” has a mature quality strategy with a continuing focus on developing suppliers to reach a higher level of performance.

— Supplier Quality Assurance Strategy —

Strategy Elements	Priorities	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection				▲			▲
Conformity to Design				▲			▲
Supplier Management	★ Supplier Development			▲			▲
Material Sourcing for Quality & Design				▲			▲
Failure Management				▲			▲
Organization				▲			▲
Technology/ Information Systems				▲		▲	

- ▲ = Observed Performance
- ★ = Key Focus Area
- ➡ = New Program

The mix of quality assurance methods used by Company “D” focuses on early defect prevention and supplier development.

← **Quality Assurance Methods Procurement Timeline** →

QA Category or Method	Origin of Need	Design Specifications Development	Supplier Selection	Start Production	In-Process	End Production	Shipment /Delivery	Final Use
Supplier Selection	Supplier Selection: 16 Steps							
			Supplier Certification: All parts shipped to production line					
Supplier Selection								
		Materials Qualification						
Conformity to Design								
			Continuous Supplier Feedback					
Supplier Management								
		Supplier Development						
Supplier Management								
	Early Supplier Involvement							
Material Sourcing for Quality and Design								

Company “D” has a defined process to perform supplier selection, materials qualification and supplier certification to help suppliers achieve the goal of zero defects delivered just-in-time.

New Components - Supplier Performance

Goal:

To deliver zero defects on a just-in-time

Quality Assurance Category	Company Specific Quality Assurance Method	Outcome of Method
Supplier Selection	Supplier Selection	Assessment of supplier quality system, JIT production capability and application of statistical process control
	Supplier Certification: All parts	Delivery of all parts direct to manufacturing line, based upon supplier selection and materials qualification
Conformity to Design	Materials Qualification	Verification and measurement of product and process reliability and capability

The quality assurance strategy of Company “D” includes methods to ensure suppliers are continuously improving product designs and processes.

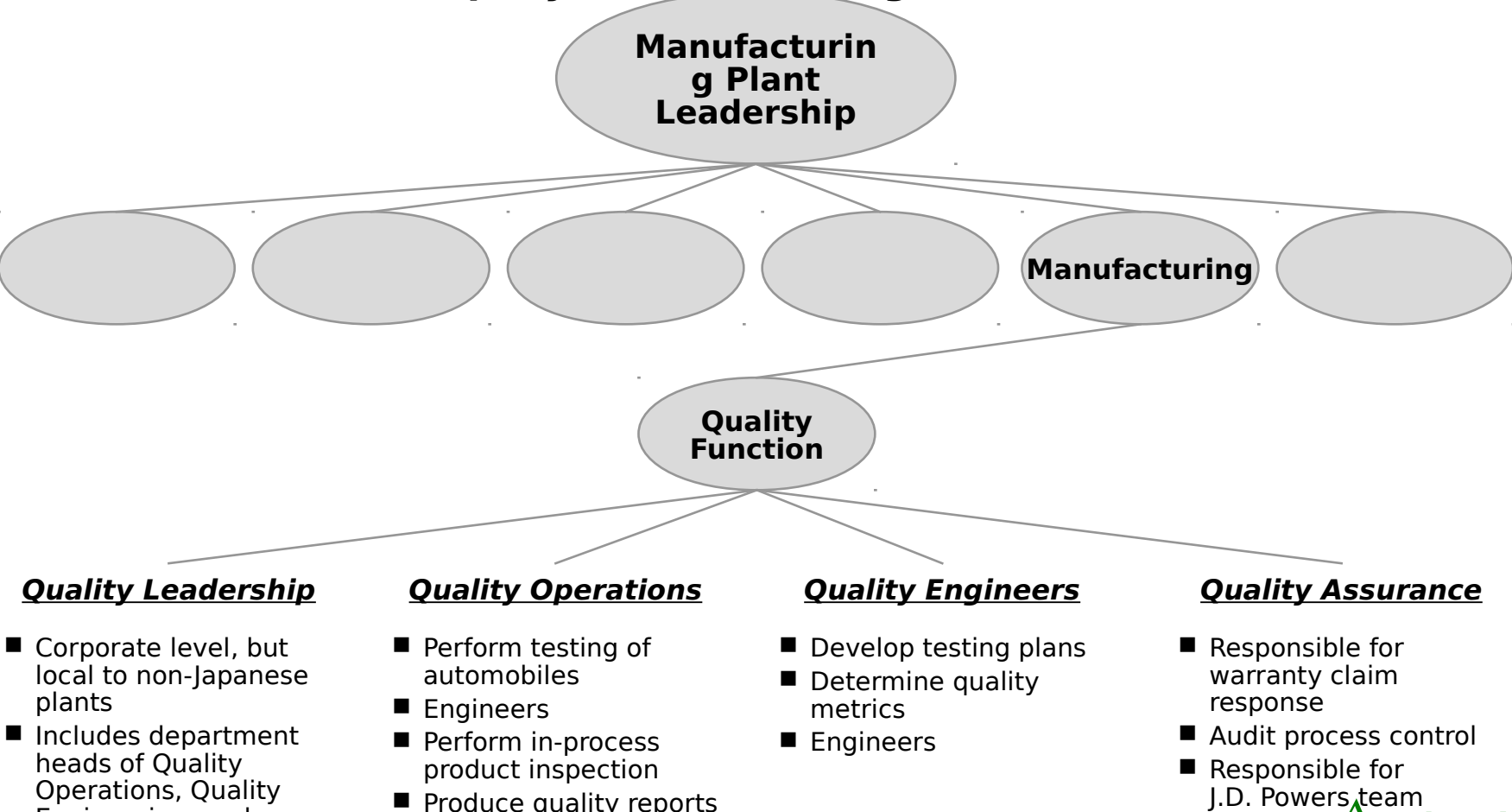
Current Components - Supplier Performance Goal:

To continuously improve process or product to reduce cost and increase quality

Quality Assurance Category	Company Specific Quality Assurance Method	Outcome of Method
Supplier Management	Continuous Supplier Feedback	Suppliers are motivated and enabled to improve product quality and performance
	Supplier Development	Jointly work on process, product and quality improvement projects
Material Sourcing for Quality and Design	Early Supplier Involvement	Provide supplier with more lead time to build and verify capability to fulfill future demand

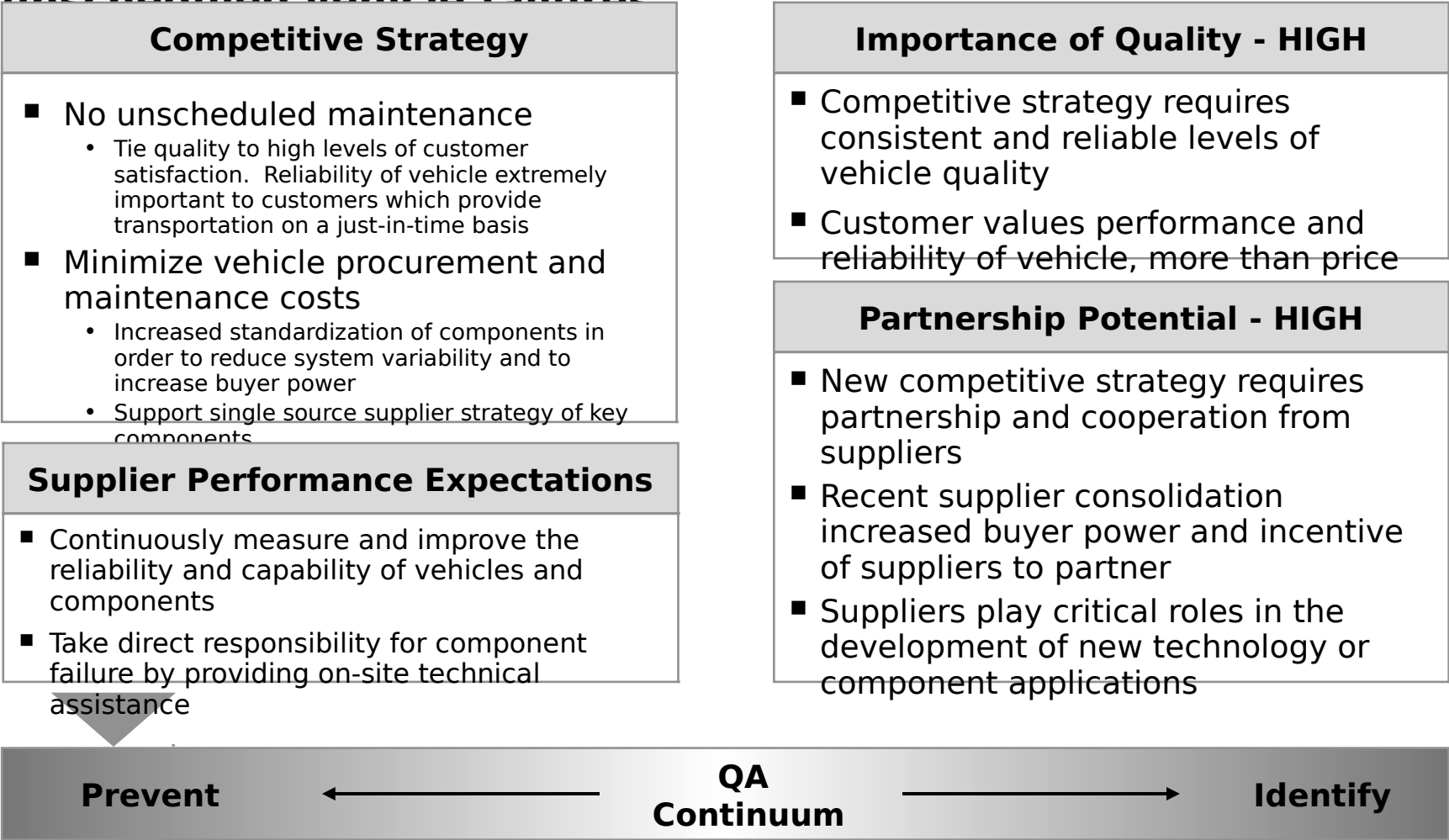
Although the manufacturing plant leadership of Company “D” rotates, the working level members of the quality organization remain stable. Standardized processes further prevent organization disruption

Company “D” Quality Organization —



Automotive Industry Company “E”

Company “E” has recently positioned quality assurance to directly support the desired strategic advantage to guarantee zero unscheduled vehicle failures



The impact of failure for vehicles and spares is extremely high. High defect rates of either would prevent Company “E” from achieving competitive advantage.

Business Impact - HIGH

- Impact of nonconformance of vehicle configuration is critical to customer satisfaction
- Impact of failure is very costly
 - Lost potential revenue due to low customer satisfaction
 - Final vehicle safety sensitive to the quality of components

Technology Risk - LOW

- Components are not crucial to current or future competitive advantage
 - Relative to the supplier’s ability to measure and verify component capability and reliability
- Manufacturing operations are not complex
 - Compared to consumer automotive manufacturing

Company “E” has re-allocated quality assurance resources and priorities to focus on achieving the “no unscheduled maintenance” business goal.

— Supplier Quality Assurance Strategy —

Strategy Elements	Priorities	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection				▲			▲
Conformity to Design	★ Predictive Failure Strategy	Predictive Maintenance	→ ▲		▲		
Supplier Management		Scorecard →	▲		▲	Rationalization of Supplier Base	
Material Sourcing for Quality & Design	★ Predictive Failure Strategy		Reduction in SPOs →			▲	
Failure Management				▲		▲	
Organization				▲			▲
Technology/ Information Systems	★ Predictive Failure Strategy					▲	

▲ = Observed Performance SPO = Supplier Purchase Orders
★ = Key Focus Area
→ = New Program

To enable more effective use of quality resources, Company “E” has taken several important actions: rationalized the supplier base, increased part standardization, and decreased customer confi

Quality Assurance Methods Procurement Timeline →

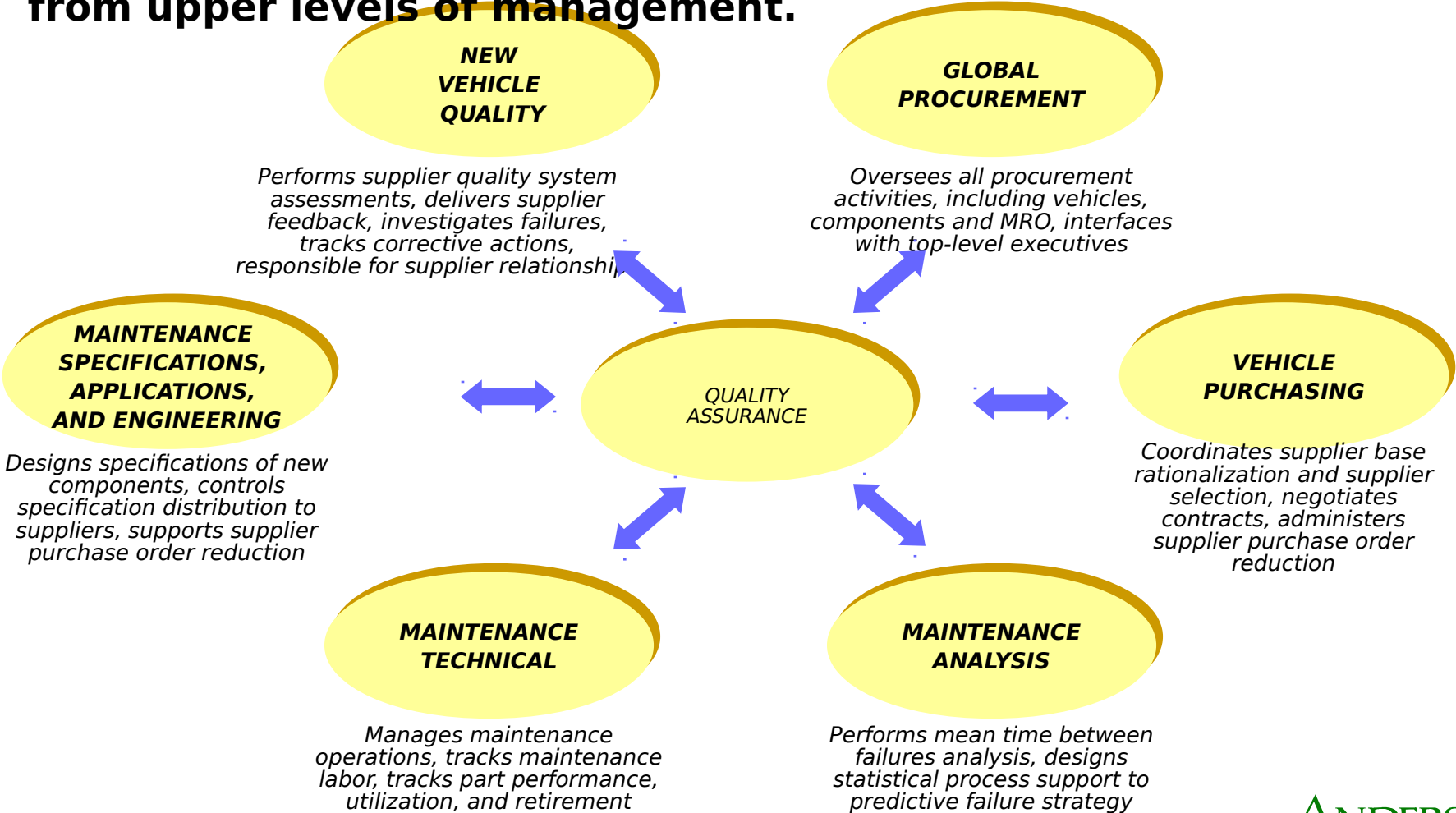
QA Category or Method	Origin of Need	Design Specifications Development	Supplier Selection	Start Production	In-Process	End Production	Shipment /Delivery	Final Use			
Supplier Selection			Cross-functional Team & Selection Worksheet								
Conformity to Design											
Conformity to Design									New Production Pilot Reviews		
Material Qualification									Field Testing		
Supplier Management			Rationalization of Supplier Base								
Supplier Management			Ongoing Qualification Continuous Communication								
Material Sourcing for Quality and Design				Root Cause Analysis & Resolution							
Material Sourcing for Quality and Design		Supplier Purchase Order Rationalization									
Failure Management								On-site Technical Supplier Support			

Company “E” is positioning every quality assurance category to support predictive maintenance, and to foster the cooperation of its suppliers.

Supplier Performance Goal: To support predictive failure and scheduled maintenance strategy by jointly measuring and testing reliability and capability of vehicles and components

Quality Assurance Category	Company Specific Quality Assurance Method	Outcome of Method
Supplier Selection	Cross-Functional Selection Teams Selection Worksheets	Cross-functional team ensured selection decisions supported competitive strategy; worksheet ensured decisions were objective and fact-based
	Ongoing Qualification Continuous Communication	New vehicle quality managed continuously evaluating quality systems of suppliers while in the field
Conformity to Design	In-service Inspection	Prepares vehicle for use and delivery to leasing customer; checks for identifiable discrepancies
	New Production Pilot Reviews	Enables leasing customer to review vehicle and provide feedback directly to supplier
	Field Testing	Enables Company “E” to evaluate performance of newly developed components for potential fleet replacement or use
Supplier Management	Rationalization of Supplier Base	Increased buyer power to support predictive failure strategy
Material Sourcing for Quality and Design	Supplier Purchase Order Rationalization	Resources of predictive maintenance strategy allocated across fewer part numbers, supported supplier rationalization and incentive for suppliers to support strategy
	Root Cause Analysis and Resolution	Improved supplier manufacturing and quality assurance processes. The goal is to reduce defects
Failure Management	On-site Technical Supplier Support	Provides supplier with immediate reliability data on spares and vehicles

Company “E” uses a cross-functional team to plan, implement and manage the quality assurance strategy. The team is composed of individuals with extensive company experience, from upper levels of management.



**Aerospace
Industry
Company “F”**

The quality of new aircraft is critical to achieving business objectives in terms of safety, reliability, and conformance. Safety is addressed externally by FAA certification, and proven by performance history.

Importance of Quality	
HIGH	The customer values quality <ul style="list-style-type: none">• Aircraft structural safety is a primary requirement
HIGH	Competitive advantage requires maintenance costs be minimized over aircraft lifecycle <ul style="list-style-type: none">• Requires high reliability• Requires actual service life meet projections
HIGH	The customer is sensitive to interior characteristics of the aircraft <ul style="list-style-type: none">• High impact of non-conformance

New Aircraft Supply Base
<ul style="list-style-type: none">■ Limited supply base (two)■ Extensive knowledge and experience■ Acceptable quality history

Other Business Factors
<ul style="list-style-type: none">■ Federal Aviation Administration (FAA) certifies airworthiness of aircraft design before production (owned by manufacturer)■ FAA certifies quality system of aircraft manufacturer prior to and during production (focus on safety)



The supplier Quality Assurance Strategy is very simple, focusing on Conformity to Design inspection activities and Failure Tracking to meet equipment lifecycle cost and interior conformance objectives.

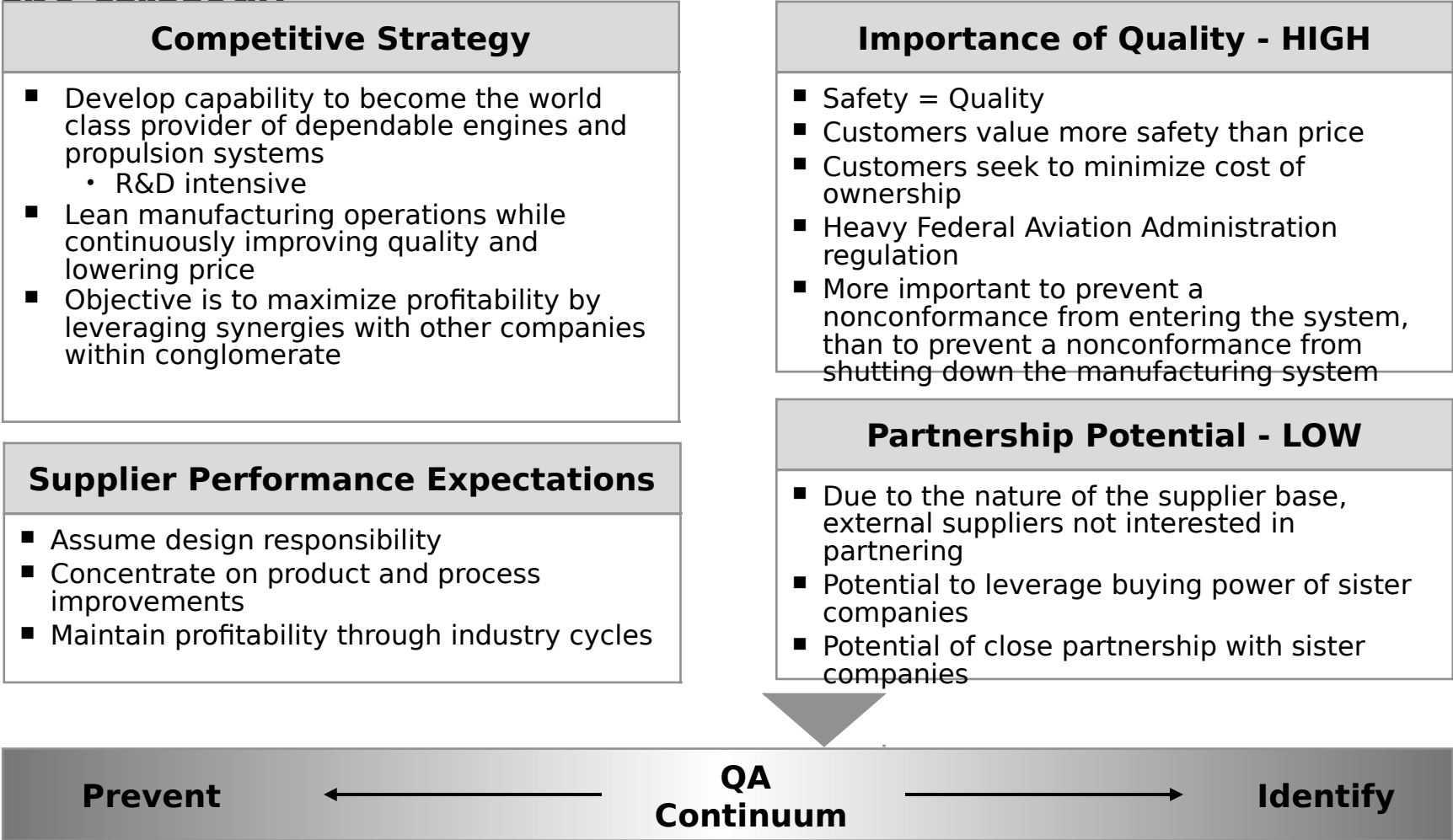
Supplier Quality Assurance Strategy —

Strategy Elements	Focus Areas	In Development	Rollout	Mature	Basic	Progressive	World Class
Supplier Selection				▲		▲ Accept FAA Production	
Conformity to Design	Reliability and Interior Conformance			▲		▲	
Supplier Management	Discrepancy Identification			▲	▲		
Material Sourcing for Quality & Design	Influence Reliability			▲		▲	
Failure Management	Lifecycle Cost Reliability			▲		▲	
Organization	Support Source Inspection			▲		▲	
Technology/ Information Systems	Lifecycle Cost Reliability			▲		▲	

- ▲ = Observed Performance
- ★ = Key Focus Area
- ➡ = New Program

**Aerospace
Industry
Company “G”**

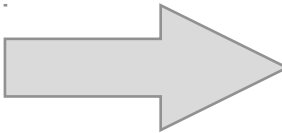
The strategy of Company “G” relies heavily on quality and safety. A sophisticated information system is instrumental to implement the strategy.



Company “G” has the most sophisticated and comprehensive information system observed, compared to the rest of the benchmark companies.

— Quality Data Visibility —

Primary User	SUPPLIER/PART PERFORMANCE								QUALITY PLAN-PART		
	Qualification Certification Status	Assessment Ratings & Progress	Corrective Actions & Deficiency Notification	Delivery Performance	Inspection Results	Manufacturing Findings	Field Failures	Overall	Critical Parameters	Type Inspection	Sample Size
Incoming Inspection	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line	On-line	On-line	On-line
Field Quality Represent.	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line	On-line	On-line	
Procurement	On-line	On-line	On-line	On-line	On-line	On-line	N/A	On-line	On-line	On-line	On-line
Suppliers	Report	Report	Report	Report	Report	Report	N/A	Report			



Global visibility of Quality Assurance data

The quality information system of Company "G" supports the goal of lean manufacturing.

— Information System Observations —

- The Company "G" Intranet supports the activities of the field quality assurance representatives.
 - It contains: audit schedules, audit results, procedures, qualified supplier list, supplier addresses and contact information, training schedules, supplier report cards, training records, available training courses, assignments, and risk categories.
- A sophisticated incoming inspection system automatically adjusts inspection levels according to supplier performance history.
 - Random frequency of over-inspection of two part numbers per supplier per month is generated by the system.
- A corrective action system includes the date each corrective action was submitted and the date the response was accepted.
- If a part or supplier has problems, receiving inspection personnel put a flag into the computer system. The flag message notes what the problem is, what tests need to be done and who to contact for more information.